INVESTIGATIONS OF NEW ENGLAND MARINE ALGAE VI: DISTRIBUTION OF MARINE ALGAE NEAR CAPE COD, MASSACHUSETTS[1]

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Cape Cod is a major phytogeographic boundary on the northeast coast of North America, delineating a distinctive northern and southern marine flora (Chapman, 1964; Humm, 1969; Setchell, 1922; Stephenson & Stephenson, 1949). Harvey (1852-1858) and Farlow (1870, 1882) first recognized its importance as a phytogeographic boundary. Additional information regarding the uniqueness of the Cape Cod flora was contributed by Collins (1900), Davis (1913a, b) and Taylor (1937, 1957).

Although the marine flora of Cape Cod has received considerable attention since the time of Harvey, no one has ever conducted simultaneous year round studies of the algae on both sides of the Cape. In addition, nothing is known about the seasonal changes that occur in the Canal, which joins Cape Cod Bay and Buzzards Bay. Conover (1958) and Sears (1971) conducted seasonal studies of the algae in southern Cape Cod, but they gave no consideration to the Canal. The purpose of the present investigation was to study the horizontal and vertical distribution of seaweeds at seven locations from Scituate to Woods Hole, Massachusetts, and reproduction including the Cape Cod Canal. The seasonal occurrence of seaweeds at the same sites will be discussed in another paper.

Monthly collections of all the conspicuous algae at seven stations (Fig. 1) were made from January to December, 1969. Severe winter conditions (heavy ice and surf) existed from December to March, and they restricted some

[1]Published with the approval of the Director of the University of New Hampshire Agriculture Experiment Station as Scientific Contribution Number 656.

collections. Specimens were collected on foot in the intertidal zone and by SCUBA diving to a depth of 60 feet in the subtidal zone. Diving in the Canal was done at slack water (Anon. 1969a). The collections were brought to the University of New Hampshire for identification and processing.

Taylor (1937, 1957, 1960) was the primary source of identification and nomenclature. A number of additional references were consulted for the identification of species and the determination of recent geographical records along the Atlantic Coast of North America subsequent to Taylor's (1960) summary. These include: Adey, 1964, 1965, 1966; Bell & McFarlane, 1933a,b; Blomquist & Humm, 1946; Cardinal, 1964, 1965, 1966, 1967a,b,c, 1968; Collins, 1909; Edelstein, *et al.*, 1967, 1969, 1970; Edelstein & McLachlan 1966, 1967a,b, 1968a,b, 1969; Fritsch, 1935, 1945; Hoek, 1964; Hoyt, 1920; Lamb & Zimmermann, 1964; Lee, 1968, 1969; Lewis, 1914; MacFarlane & Bell, 1933; McFarlane & Milligan, 1965; Mathieson & Fuller, 1969; Mathieson, Dawes & Humm, 1969; Rhodes, 1970; South & Cardinal, 1970; Stone, *et al.*, 1970; Wilce, 1959, 1965; Williams, 1948, 1949; Wulf, *et al.*, 1968; Zaneveld & Barnes, 1965; Zaneveld, 1965, 1966a,b, 1972. The nomenclature of Parke & Dixon (1968) was applied in most cases.

Surface water temperature and salinity information was recorded when each station was investigated. Temperature was determined with a laboratory grade mercury thermometer; salinity was measured with a set of hydrometers (G. M. Mfg., Co.). In addition, hourly and daily surface water temperature data were obtained for each end of the Canal from thermographs monitored by the Fisheries Division of the State of Massachusetts. Additional (daily) temperature and salinity information was supplied by the Woods Hole Oceanographic Institute, Falmouth, Massachusetts (personal communication with Dean Bumpus and Joseph Chase).

Figure 1 illustrates the location of the seven study sites. One station (Scituate) was located north of the east end of the Canal, four were in the Canal proper and two (Woods

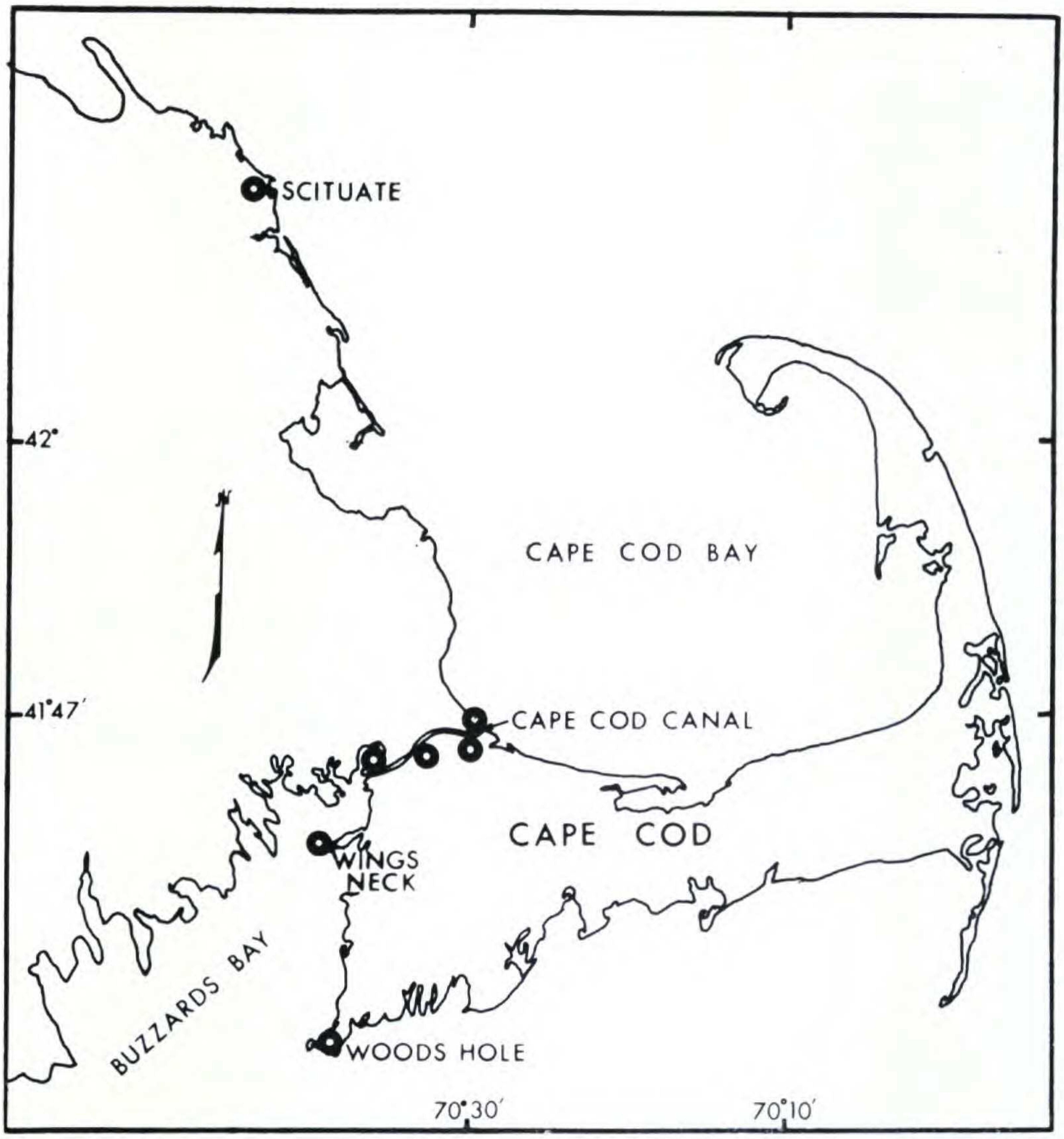

Figure 1. Map of Cape Cod, Massachusetts, showing the seven stations.

Hole and Wings Neck) were located south of the west end of the Canal. The land-cut of the Canal cuts across the Cape in an east-west direction from the town of Buzzards Bay (approximately 41°44′ N Latitude, 70°37′ W Longitude) to Sandwich (approximately 41°46′ N Latitude, 70°30′ W Longitude). It is seven miles in length, with an additional seven miles of approach channels.

Several differences are obvious between the two sides of the Cape. To the north, the substrate consists of granite outcrops, boulders and cobbles, while to the south the sub-

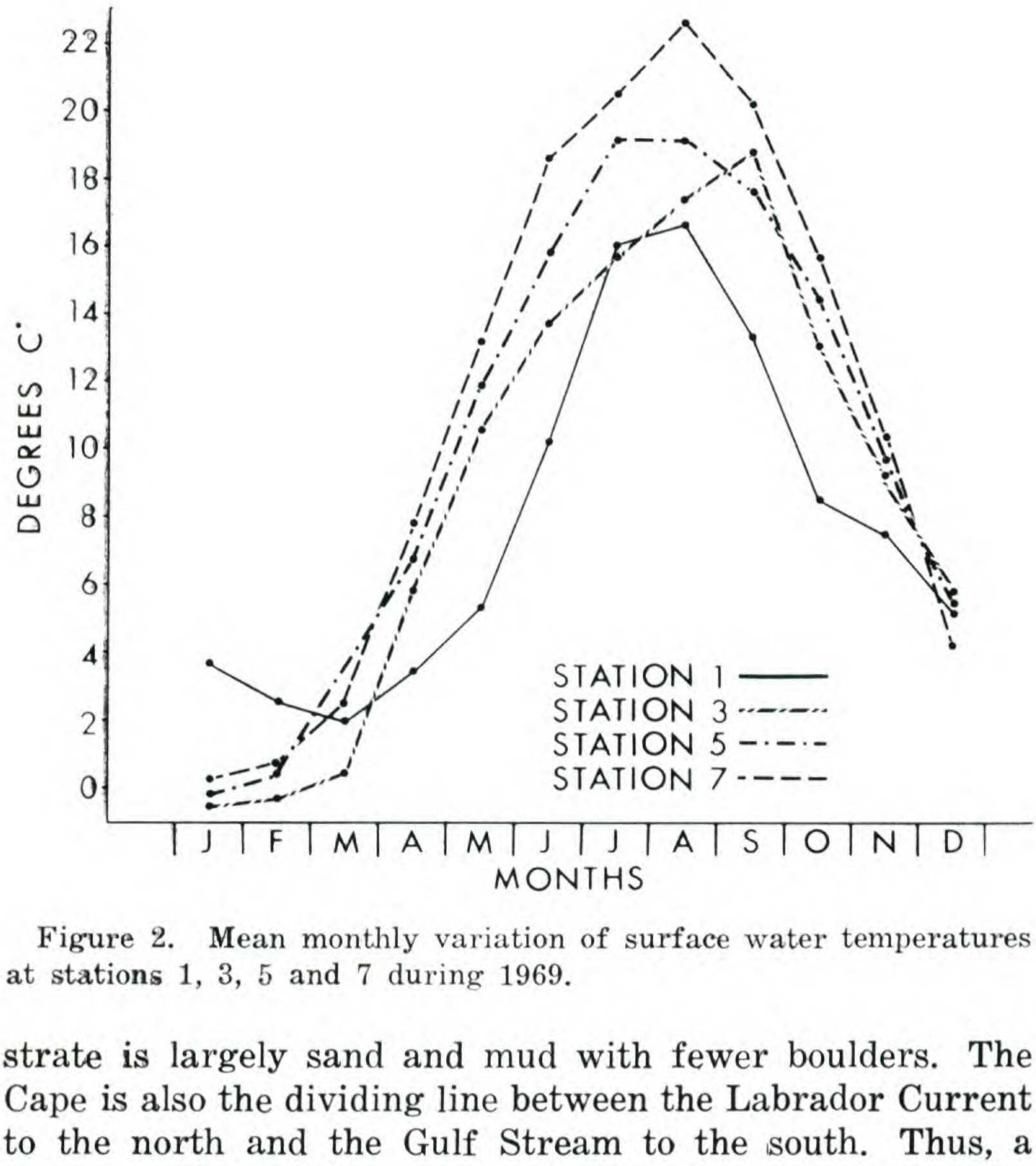

Figure 2. Mean monthly variation of surface water temperatures at stations 1, 3, 5 and 7 during 1969.

strate is largely sand and mud with fewer boulders. The Cape is also the dividing line between the Labrador Current to the north and the Gulf Stream to the south. Thus, a marked difference in water temperatures occurs during the summer. The yearly temperature range south of the Cape was approximately 22°C., while that to the north was about 17°C. (Fig. 2). The salinity ranges south of the Cape were usually higher than those to the north, particularly during spring and summer (Fig. 3). The tidal amplitude is much greater on the north than the south side. Thus, a three foot tidal amplitude exists in Buzzards Bay, while it is approximately ten feet at Scituate (Anon. 1969a). The waters of Cape Cod Bay are over 100 feet deep while those in Buzzards Bay are shallower.

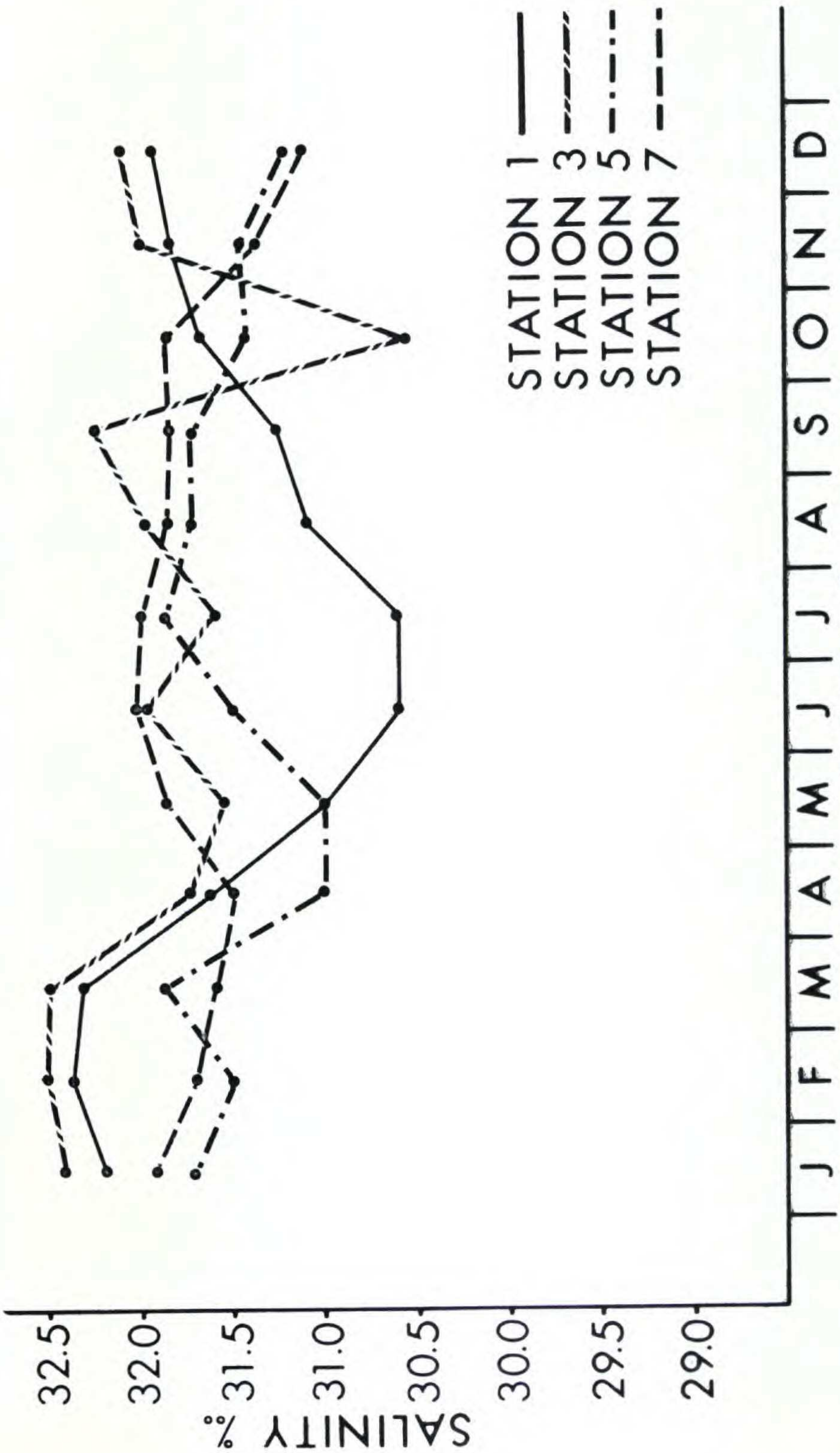

Figure 3. **Mean** monthly variation of surface water salinity at stations 1, 3, 5 and 7 during 1969.

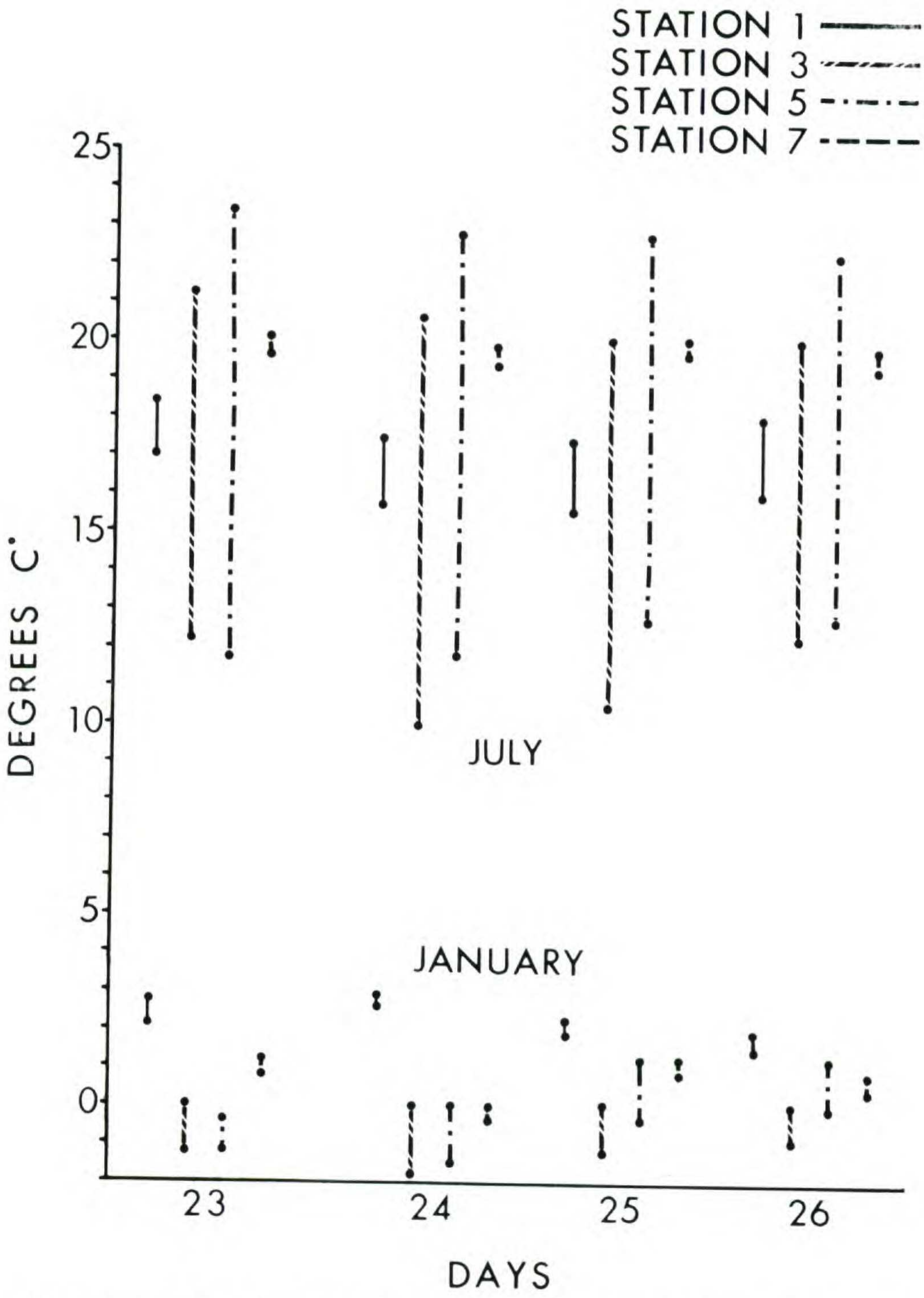

Figure 4. Mean daily variation of surface water temperatures at stations 1, 3, 5 and 7 during January and July, 1969.

The Canal has a limited amount of solid substrate, no wave action and a reduced intertidal zone. The seasonal temperature ranges are intermediate between the north and south sides of the Cape, but daily fluctuations during the summer are greater than on either side of the Cape (Fig. 4). The summer temperatures in the Canal are somewhat lower in the east than the west end (Fig.2). Seasonal and spatial variations of salinity are minimal (Fig. 3). The tidal amplitude in the Canal ranges from four feet in the west end to ten feet in the east end (Anon. 1969b). There is a difference of about two hours between the tides at the two ends (Anon. 1969b). The current reaches a peak of about six knots, three hours after slack water. Slack water occurs uniformly throughout the Canal, and it does not coincide with either high or low water (Anon. 1969b). The substrate at each site in the Canal grades vertically from granitic boulders to sand-silt. In addition, there is a general decrease in stable substrate towards the east end.

The Canal is maintained by the Army Corps of Engineers. A private access road along the banks was used to reach the stations. Telephone poles are located at 100 foot intervals along the Canal; they are numbered beginning at the east end. Stations 2-5 were located in the Canal and correspond to poles 10, 45, 245 and 385 respectively. Station 3 (pole 45) is located in front of the Cape Cod Canal Power Plant. A detailed description of the Canal stations, plus the Scituate, Wings Neck and Woods Hole sites is summarized in the Appendix.

SPECIES COMPOSITION

A total of 106 taxa was collected at the seven stations, including 52 Rhodophyta, 35 Phaeophyta and 19 Chlorophyta. Table I summarizes the species composition at each station. Scituate and Woods Hole showed the greatest diversity of species, while stations 2-6 showed lower numbers. No subtidal collections were made at station 2. It is of interest to note that the relative percentages of Rhodophyta, Phaeophyta and Chlorophyta were about the same at each station.

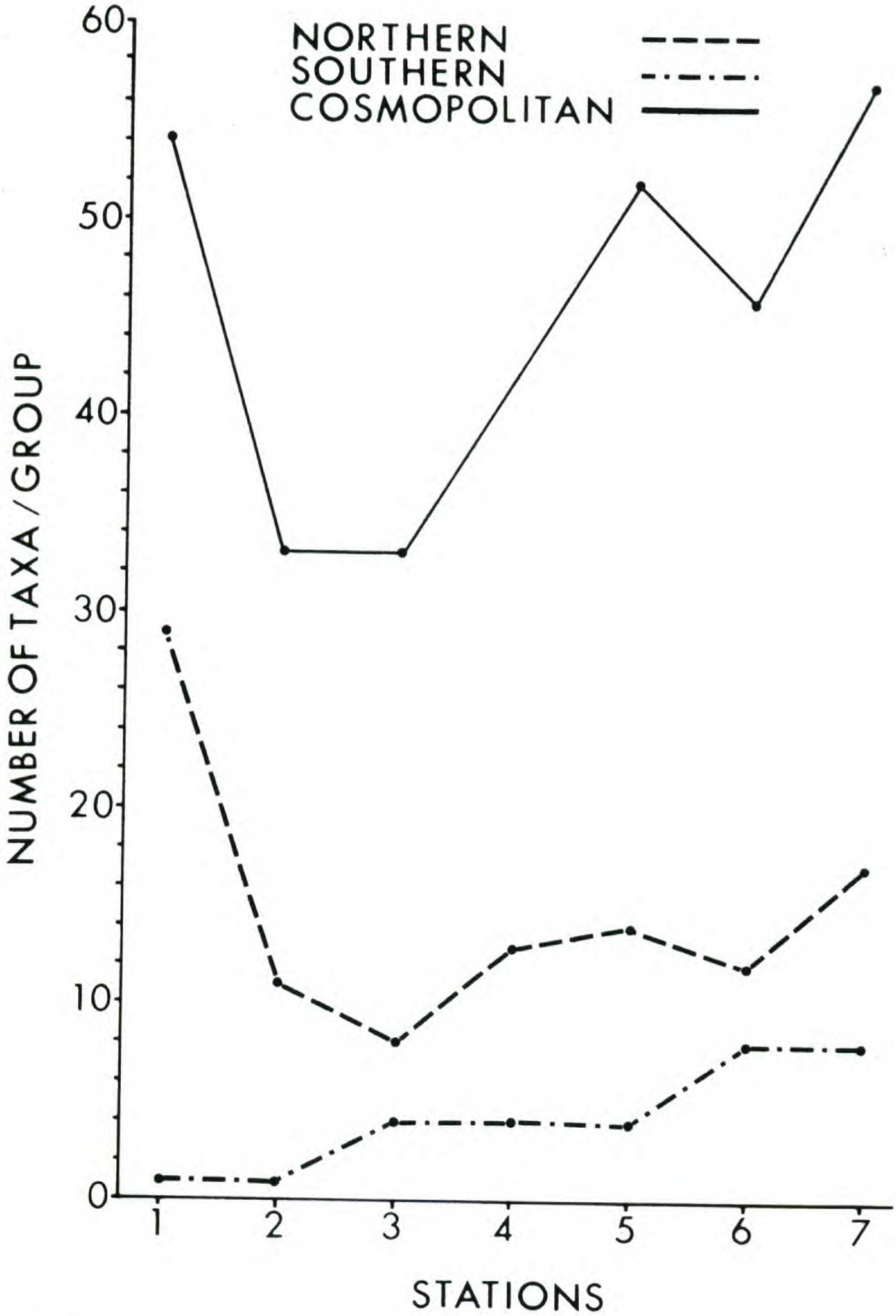

Figure 5. Number of northern, southern and cosmopolitan species at each station.

A listing of the known geographical distribution of each taxon along the Atlantic Coast of North America is also designated numerically in Table I. The species can be grouped into three components (i.e., northern, southern and cosmopolitan) according to their major centers of distribution. The northern species are found most commonly north of the Cape, and they include groups 1, 2, 3, 4 and 15. The southern species are more common south of the Cape; they include groups 7, 11, 12 and 13. Cosmopolitan species are found on each side of the Cape, and they include groups 5, 6, 8, 9, 10, 14 and 16.

Figure 5 summarizes the number of northern, southern and cosmopolitan species at each station. Most of the species were cosmopolitan. The northern component declined towards the south, while the southern component increased towards the south, reaching a maximum at Wings Neck and Woods Hole. Cosmopolitan species included *Chaetomorpha melagonium, Rhizoclonium tortuosum, Ulva lactuca, Ascophyllum nodosum, Petalonia fascia, Ahnfeltia plicata* and *Ceramium rubrum,* while conspicuous northern components included *Codiolum petrocelidis, Monostroma* spp., *Chorda filum, Fucus spiralis, Laminaria digitata, Choreocolax polysiphoniae,* and *Porphyra umbilicalis.* Representative species more common to the south of the Cape included *Codium fragile* subsp. *tomentosoides, Sargassum filipendula, Agardhiella tenera, Champia parvula* and *Hypnea musciformis.*

Scituate had a species composition typical of northern New England, while Wings Neck and Woods Hole were more typical of warmer water locations. Thus, *Laminaria* spp., *Gigartina stellata, Ralfsia fungiformis, Chaetomorpha atrovirens, Urospora collabens,* and *Fucus vesiculosus* were common at the former station, while *Sargassum filipendula, Agardhiella tenera, Callithamnion baileyi,* and *Codium fragile* subsp. *tomentosoides* were common at the latter stations. The Canal stations, 3-5, included representatives from both sides of the Cape (e.g. *Laminaria saccharina, Chondrus crispus, Rhodymenia palmata, Agardhiella tenera, Codium fragile* subsp. *tomentosoides* and *Sargassum filipendula.*

VERTICAL DISTRIBUTION

Figure 6 summarizes the vertical distribution of the conspicuous species at each station. The distributions were recorded as follows: 1) species restricted to the intertidal zone; 2) species restricted to the subtidal zone; 3) species found in both the intertidal and subtidal zones. Most of the plants at Scituate were collected from the intertidal and subtidal zones, including tide pools. Species that were common to both zones included *Chondrus crispus, Chorda* spp., *Ectocarpus siliculosus, Petalonia fascia, Ceramium rubrum, Corallina officinalis, Dumontia incrassata,* and *Chaetomorpha linum.* Few species (e.g. *Chaetomorpha atrovirens, Cladophora flexuosa, Polyides rotundus, Asperococcus echinatus,* and *Laminaria* spp.) were restricted to the subtidal zone or intertidal zone (e.g. *Codiolum* spp., *Enteromorpha intestinalis, Rhizoclonium tortuosum, Ulothrix flacca, Choreocolax polysiphoniae,* and *Fucus spiralis*). Subtidal substrate was lacking at station 2, and the lowest number of species was found here.

The Canal stations (2-5) had the highest subtidal component. Species restricted to the subtidal zone in the Canal were also found in the intertidal zone at other stations. The most common subtidal species in the Canal included *Laminaria* spp., *Chondrus crispus, Agardhiella tenera, Chorda* spp., *Chordaria flagelliformis, Ulva lactuca, Petalonia fascia,* and *Scytosiphon lomentarius.* Species restricted to the intertidal zone included *Urospora penicilliformis, Ascophyllum nodosum, Fucus spiralis,* and *Choreocolax polysiphoniae;* those common to both zones included *Ectocarpus siliculosus, Fucus vesiculosus,* and *Sphacelaria cirrosa.*

The majority of species collected at Wings Neck and Woods Hole was found in the subtidal zone and the intertidal-subtidal zones. Few species were restricted to the intertidal zone. Species restricted to the subtidal zone included *Agardhiella tenera, Sargassum filipendula, Callithamnion roseum, Dasya pedicellata, Seirospora griffithsiana, Leathesia difformis, Chordaria flagelliformis,* and *Clado-*

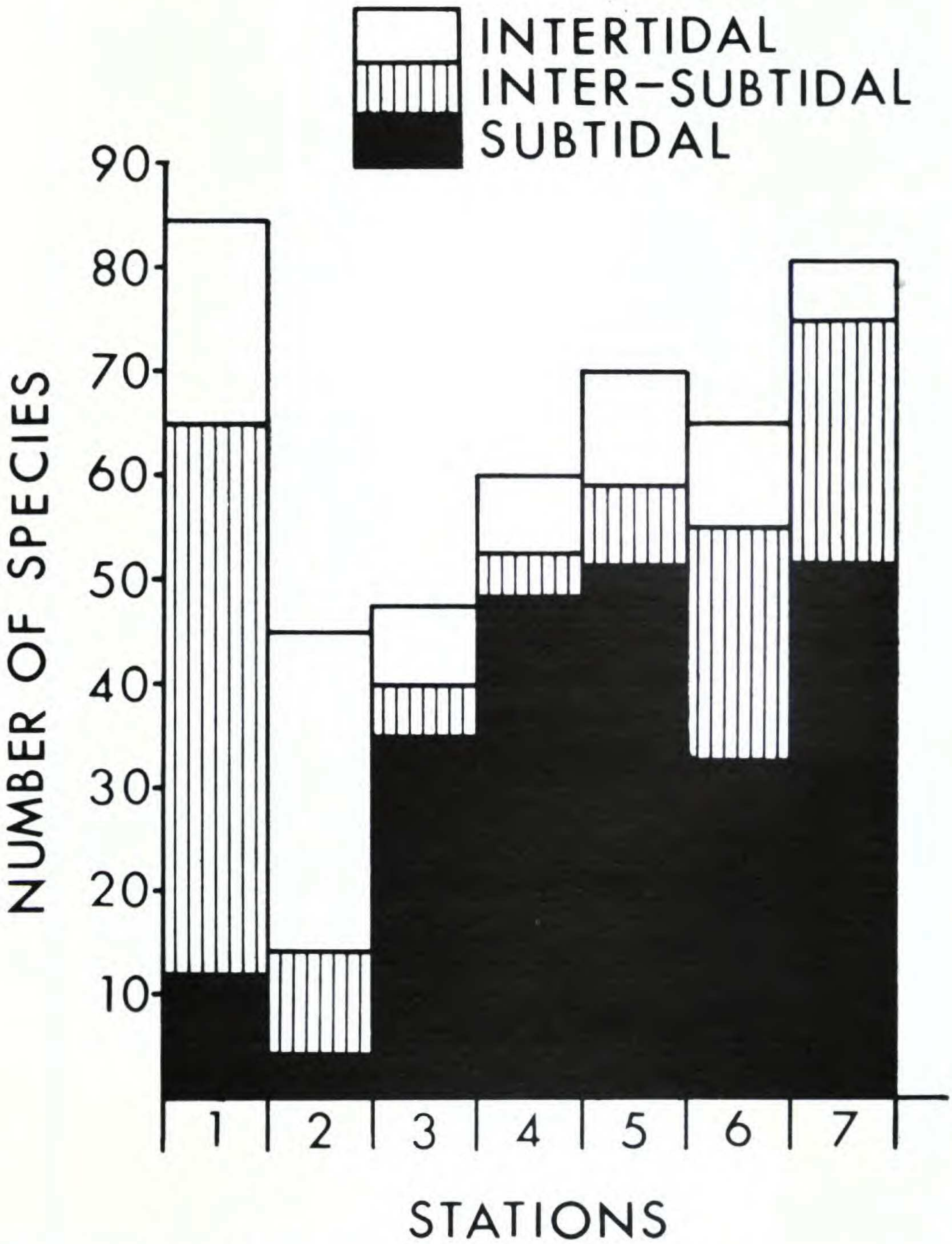

Figure 6. Vertical distribution of species at each station.

phora spp. Species found in both zones included *Chondrus crispus, Melobesia lejolisii, Ectocarpus siliculosus, Fucus vesiculosus* var. *spaerocarpus,* and *Chaetomorpha linum,* while those restricted to the intertidal zone included *Bangia fuscopurpurea, Porphyra umbilicalis, Fucus spiralis,* and *Ulothrix flacca.*

DISCUSSION

Setchell (1917) was one of the first workers to emphasize the role of temperature in determining the geographical distribution of seaweeds. He divided the oceans into 5°C. intervals or isotherms, according to the maximum summer water temperatures. Hutchins (1947) also confirmed that 5°C. intervals either favored or inhibited growth and repopulation of marine organisms. Williams (1948), Parr (1933), Well and Gray (1960), and Humm (1969) have reported a similar relationship between temperature and species composition. As suggested by Setchell (1917) Cape Cod is a dividing line between the 15° and 20°C. maximum summer isotherms. Hence, it is not surprising that it is a major phytogeographic boundary, with distinct floras occurring north and south of the Cape.

Several factors are responsible for the marked difference in summer temperatures between the north and south side of Cape Cod. A southern extension of the Labrador Current carries cold water as far south as the Cape, where it remains throughout the year. In addition, the deep waters of Cape Cod Bay warm up slowly during the summer. Davis (1913a, b) described Cape Cod Bay as a "holding pocket" of cold water. He further described the islands of Martha's Vineyard and Nantucket as barriers protecting Buzzards Bay from the intrusion of cold waters off Gay Head. The high surface water temperatures in Buzzards Bay result from a northern extension of the Gulf Stream into the shallow confines of Buzzards Bay. During the winter, cold air lowers the temperature on both sides of the Cape and the sharp differential of temperature disappears. Winter temperatures in Buzzards Bay, however, may be somewhat lower than in Cape Cod Bay, because of the shallowness of the water of the former location.

The transitional nature of the Cape Cod Canal is documented by its species composition. The Canal is dominated by cosmopolitan species; northern species increase toward the east end of the Canal, while southern components increase toward the west end. Setchell (1922) also recognized a cosmopolitan group of plants common to both sides of the Cape — in contrast to more northern and southern elements. The completion of the Canal in 1914 presumably provided a direct route for spores to pass from one side to the other. Stephenson (1944) has shown a similar transition of flora and fauna near the Cape of Good Hope in Africa; on the west coast the waters are relatively cold, while on the east coast the shore is bathed by the warm waters of the Indian Ocean. Seven major components are evident near the Cape of Good Hope; the major components are the cosmopolitan, warm- and cold-water elements.

Physical factors, such as tidal amplitude, wave action and availability of solid substrate, determine the local distribution of species at the seven sites. Salinity was not considered a major factor in the areas studied because of the small range recorded. Scituate had the highest number of species; it is the most exposed site having ample substrate. The lack of wave action, lower tidal amplitude, and reduced substrate in the Canal were probably responsible for the low number of species at stations 2-5. Woods Hole had the second highest number of species, even though tidal amplitude, wave action, and substrate were reduced south of the Cape. The abrasive action of sand at Wings Neck resulted in low species numbers.

A variety of physical factors, such as temperature, salinity, light intensity, substrate and exposure, determine the vertical distribution of seaweeds (Stephenson & Stephenson, 1949; Chapman, 1964). Most algae at Scituate were collected from the intertidal and subtidal zones, while in the Canal and south of the Cape the majority of species was restricted to the subtidal zone. The former location (Scituate) is characterized by greater tidal amplitude and wave action, both of which are necessary for the development of an extensive intertidal flora — assuming substrate is not limiting. The vertical position of species varied from station to station. Species found in the intertidal and subtidal zones at Scituate were often restricted to the subtidal zone in the Canal or south of the Canal.

ACKNOWLEDGEMENTS

We would like to thank Dr. A. Hodgdon for his critical review of the manuscript. In addition we express our gratitude to Dr. R. Fralick, Dr. R. Turner, and Mr. John Hansman for their assistance with diving and collection of specimens, to the Army Corps of Engineers at Cape Cod for diving access to the Cape Cod Canal, and to Dean Bumpus and Joseph Chase for the use of unpublished temperature and salinity data.

APPENDIX

Description of Stations

Scituate (station 1) is located about 30 miles north of the east end of the Canal at approximately 42°12′ N latitude and 70°43′ W longitude (Fig. 1). It is a semi-exposed site, consisting of massive granite outcroppings. There are several tide pools and a well developed intertidal zone. The substrate in the subtidal zone consists of large outcroppings, boulders, cobbles and sand. The surface water temperatures ranged from approximately 2-16°C. The highest temperatures occurred in August, while the lowest occurred in March. The daily temperature range was about 2°C. during the summer and 3°C. during the winter. The average monthly summer temperatures at Scituate were the lowest of all the stations. Salinity values remained relatively constant throughout the year, ranging from a low of 30.6‰ in the summer to a high of 32.5‰ during the winter.

Station 2 is located at the east end of the Canal at the Scusset Breakwater (Fig. 2). Collections were restricted to the intertidal zone because of the lack of subtidal substrate. An extensive intertidal zone is present. The water temperatures ranged from 12°C. to 19°C. The tidal amplitude is 10 feet (Anon. 1969a).

Station 3 is located at the power plant (Fig. 2). Rip-rap extends to about 6 feet below M.L.W., while a shelf extends out 30-40 feet and to a depth of 15 feet. During operation, the power plant discharges water of over 23.9°C. Substrate is limited and a small intertidal zone is present. The tidal amplitude is approximately 10 feet.

Station 4 is approximately 2.5 miles east of the west end of the Canal proper (Fig. 2). The study site was on the south bank of the Canal. The substrate grades from rocks (boulders) in the upper shore to sand-silt in the lower subtidal zone. The tidal amplitude is about 6 feet (Anon. 1969a). A limited intertidal zone is exposed during low tide.

Station 5 is located at the Engineer's station at the west end of the Canal. Collections were made in the vicinity of the pier. Rip-rap extends to about 12 feet below M.L.W., while a shelf extends out to about 75 feet and slopes to about 20 feet below M.L.W. The tidal amplitude is about 4 feet (Anon. 1969a).

Wings Neck (station 6) is located at approximately 41°31′ N latitude and 70°40′ W longitude in the town of Bourne, Massachusetts (Fig. 1). It is a semi-exposed area subject to southwest winds during the summer. A limited intertidal zone is present; it is composed of small cobbles and a few large boulders. A few shallow tide pools are evident. The tidal amplitude is about 4 feet (Anon. 1969a). The range of water temperatures was 0.2-22.1°C. The mean monthly winter temperature (2.2°C.) was lowest in January. At that time the temperature was lower than at Scituate, the northernmost station. The area is subject to severe ice scouring during the winter. The salinity remained relatively constant throughout the year, with a range of about 0.9‰ (Fig. 4).

Woods Hole (station 7) is located at approximately 41°31′ N latitude and 70°40′ W longitude in the town of Falmouth, Massachusetts (Fig. 1). Collections were made at the jetty behind the U. S. Fisheries Building. The bottom is approximately 20 feet below M.L.W., at the deepest point, and the bottom substrate is composed of sand and silt. Some small rocks were present at one side of the jetty. The tidal amplitude is about 2 feet (Anon. 1969a). The temperature ranged from a low of 0.2°C. in January to 22.5°C. in August (Fig. 3). Daily temperature ranges were small during the year (Fig. 5). The salinity remained relatively constant throughout the year with a range of only 0.8‰ (Fig 4).

Footnotes to Table I

[1]Geographical distribution zones relating to Table I, right hand column.

1. Northern Massachusetts to Newfoundland and north.
2. Northern Massachusetts to Nova Scotia.
3. Southern New England-Long Island Sound to Gaspé and Labrador.
4. Southern New England-Long Island to Newfoundland and north.
5. New Jersey-Maryland to Newfoundland and north.
6. New Jersey-Maryland to Gaspé and Labrador.
7. New Jersey-Maryland to Cape Cod.
8. North Carolina to Newfoundland and north.
9. North Carolina to Gaspé.
10. South Carolina to Newfoundland and north.
11. South Carolina to northern Massachusetts.
12. Tropics to southern New England-Cape Cod.
13. Tropics to northern Massachusetts.
14. Tropics to Newfoundland and north.
15. Southern New England-Long Island Sound to northern New England-Nova Scotia.
16. Tropics to northern New England-Nova Scotia.

[2] = *Neoagardhiella baileyi* (Harvey *ex* Kützing) Wynne *et* Taylor. (Wynne and Taylor, 1937).

[3] = *Phyllophora truncata* (Pallas) Newroth *et* Taylor. (Newroth and Taylor, 1971).

[4] = *Phyllophora pseudoceranoides* (Gmelin) Newroth *et* Taylor. (Newroth and Taylor, 1971).

TABLE I. DISTRIBUTION OF SPECIES

Chlorophyta Taxon	Distribution Station 1	2	3	4	5	6	7	[1]Geo- graphical
Chaetomorpha atrovirens Taylor	X							4
Chaetomorpha linum (Müller) Kützing	X	X	X	X	X	X	X	14
Chaetomorpha melagonium (Weber *et* Mohr) Kützing	X	X		X	X		X	5
Cladophora flexuosa (Müller) Harvey	X			X	X	X	X	14
Cladophora gracilis (Griffiths *ex* Harvey) Kützing	X					X	X	14
Codiolum gregarium A. Braun	X	X						3
Codiolum petrocelidis Kuckuck	X							2
Codium fragile (Sur.) Hariot subsp. *tomentosoides* (van Goor) Silva			X	X	X	X	X	7
Enteromorpha intestinalis (L.) Link	X	X	X	X	X	X	X	14
Enteromorpha linza (L.) J. Agardh	X	X			X		X	14
Monostroma grevillei (Thuret) Whittrock	X	X				X	X	4
Monostroma pulchrum Farlow	X	X				X	X	4
Rhizoclonium tortuosum Kützing	X	X						8
Spongomorpha arcta (Dillwyn) Kützing	X	X			X	X	X	5
Spongomorpha spinescens Kützing	X	X						1
Ulothrix flacca (Dillwyn) Thuret	X	X				X	X	8
Ulva lactuca L.	X	X	X	X	X	X	X	12
Urospora collabens (C. Agardth) Homes *et* Batters	X							1
Urospora penicilliformis (Roth) Areschoug	X	X			X	X	X	4
Subtotal	18	13	4	6	9	11	13	

TABLE I cont.

Taxon (Phaeophyta)	Station 1	2	3	4	5	6	7	[1]Geographical
Ascophyllum nodosum (L.) Le Jolis	X	X	X	X	X	X	X	8
Asperococcus echinatus (Mertens) Greville	X		X	X	X	X	X	4
Chorda filum (L.) Stackhouse	X	X	X	X	X	X	X	5
Chorda tomentosa Lyngbye	X	X	X	X	X	X	X	3
Chordaria flagelliformis (Müller) C. Agardh	X	X	X	X	X	X	X	5
Desmarestia aculeata (L.) Lamouroux	X	X	X	X	X			5
Desmarestia viridis (Müller) Lamouroux	X		X	X	X	X	X	5
Desmotrichum balticum Kützing	X		X				X	3
Desmotrichum undulatum (J. Agardh) Reinke						X	X	9
Dictyosiphon foeniculaceus (Hudson) Greville	X					X	X	5
Ectocarpus siliculosus (Dillwyn) Lyngbye	X	X	X	X	X	X	X	14
Elachista fucicola (Velley) Areschoug	X	X	X		X	X	X	5
Fucus distichus L. emend. subsp. *distichus* (C. Agardh) Powell	X							1
Fucus distichus L. emend. subsp. *endentatus* (C. Agardh) Powell	X	X			X			5
Fucus distichus L. emend. subsp. *evanescens* (C. Agardh) Powell	X	X	X	X	X			4
Fucus spiralis L.	X	X	X	X	X	X	X	4
Fucus vesiculosus L.		X	X	X	X			8

TABLE I — Phaeophyta cont.

Taxon	Distribution: Station 1	2	3	4	5	6	7	[1]Geographical
Fucus vesiculosos var. *sphaerocarpus* J. Agardh					X	X	X	3
Fucus vesiculosus var. *spiralis* Farlow	X						X	6
Giffordia granulosa (Smith) Hamel				X	X		X	5
Giffordia secunda (Kützing) Batters							X	15
Laminaria digitata (Hudson) Lamouroux	X			X				4
Laminaria saccharina (L.) Lamouroux	X	X	X	X	X		X	5
Leathesia difformis (L.) Areschoug	X		X	X	X	X	X	8
Myrionema strangulans Greville	X		X	X	X	X	X	14
Petalonia fascia (Müller) Kuntze	X	X	X	X	X	X	X	14
Pilayella littoralis (L.) Kjellman	X	X	X	X	X	X	X	5
Punctaria latifolia Greville			X		X	X	X	5
Punctaria plantaginea (Roth) Greville						X	X	5
Ralfsia fungiformis (Gunner) Setchell *et* Gardner	X					X	X	1
Ralfsia verrucosa (Areschoug) J. Agardh	X	X	X	X	X	X	X	5
Sargassum filipendula C. Agardh		X	X		X	X	X	12
Scytosiphon lomentarius (Lyngbye) Link	X	X	X	X	X	X	X	14
Sphacelaria cirrosa (Roth) C. Agardh	X	X	X	X	X	X	X	4
Sphaerotricia divaricata (C. Agardh) Kylin					X	X	X	5
Subtotal	26	18	23	21	26	24	29	

TABLE I cont.

Taxon	Distribution: Station 1	2	3	4	5	6	7	[1]Geo-graphical
Rhodophyta								
Agardhiella tenera (J. Agardh) Schmitz[2]	X		X	X	X	X	X	12
Ahnfeltia plicata (Hudson) Fries	X	X	X	X	X	X	X	5
Antithamnion americanum (Harvey) Farlow							X	5
Bangia fuscopurpurea (Dillwyn) Lyngbye	X	X			X	X	X	14
Bonnemaisonia hamifera Hariot				X				15
Callithamnion baileyi Harvey	X					X	X	5
Callithamnion roseum (Roth) Lyngbye				X	X	X	X	16
Ceramium rubrum (Hudson) C. Agardh	X	X	X	X	X	X	X	14
Ceramium strictum Harvey	X			X		X	X	16
Champia parvula (C. Agardh) Harvey				X		X	X	13
Chondria sedifolia Harvey						X	X	12
Chondrus crispus Stackhouse	X	X	X	X	X	X	X	5
Choreocolax polysiphoniae Reinsch	X	X	X	X	X			4
Clathromorphum circumscriptum (Strømfelt) Foslie	X							1
Corallina officinalis L.	X		X	X	X	X	X	14
Cystoclonium purpureum (Hudson) Batters var. *cirrhosum* Harvey	X		X	X	X	X	X	15
Dasya pedicellata (C. Agardh) C. Agardh			X		X	X	X	11
Dermatolithon pustulatum (Lamouroux) Foslie	X					X	X	15
Dumontia incrassata (Müller) Lamouroux	X	X	X	X	X	X		3

TABLE I — Rhodophyta cont.

Taxon	Distribution: Station 1	2	3	4	5	6	7	[1]Geographical
Gigartina stellata (Stackhouse) Batters	X							4
Gloiosiphonia capillaris (Hudson) Carmichael *ex* Berkeley	X				X		X	4
Goniotrichum alsidii (Zanardini) Howe				X	X	X	X	4
Griffithsia tenuis C. Agardh				X				11
Grinnellia americana (C. Agardh) Harvey			X	X	X	X	X	11
Hildenbrandia prototypus Nardo	X	X			X	X	X	14
Hypnea musciformis (Wulfen) Lamouroux						X	X	12
Lithophyllum corallinae (Crouan) Heydrich	X							15
Lithothamnium glaciale Kjellman	X							1
Lomentaria baileyana (Harvey) Farlow	X				X	X	X	16
Lomentaria orcadensis (Harvey) Collins *ex* Taylor				X	X			15
Melobesia lejolisii Rosanoff				X		X	X	16
Petrocelis middendorfii (Ruprecht) Kjellman	X							15
Phyllophora brodiaei (Turner) Endlick[3]	X			X	X		X	5
Phyllophora membranifolia (Goodenough *ex* Woodward) J. Agardh[4]	X		X	X	X	X	X	5
Phymatolithon lenormandi (Areschoug) Adey	X							6
Plumaria elegans (Bonnemaison) Schmitz	X	X						5

TABLE I — Rhodophyta cont.

Taxon	Distribution							
	Station							[1]Geo-
	1	2	3	4	5	6	7	graphical
Polyides rotundus (Hudson) Greville	X		X	X	X	X	X	4
Polysiphonia denudata (Dillwyn) Greville *ex* Harvey in Hooker	X		X	X	X		X	16
Polysiphonia elongata (Hudson) Sprengel			X	X	X			4
Polysiphonia harveyi Bailey	X	X		X		X	X	10
Polysiphonia lanosa (L.) Tandy	X	X	X	X	X	X	X	5
Polysiphonia nigrescens (Hudson) Greville	X	X	X	X	X	X	X	10
Polysiphonia novae-angliae Taylor	X			X	X		X	5
Polysiphonia urceolata (Lightfoot *ex* Dillwyn) Greville	X		X	X	X	X	X	5
Porphyra leucosticta Thuret				X		X	X	9
Porphyra miniata (C. Agardh) C. Agardh	X				X		X	1
Porphyra umbilicalis (L.) J. Agardh	X	X	X	X	X	X	X	10
Rhodochorton penicilliforme (Lightfoot) Rosenvinge	X	X						4
Rhodomela confervoides (Hudson) Silva	X		X	X	X		X	5
Rhodymenia palmata (L.) Greville	X	X	X	X	X		X	5
Seirospora griffithsiana (Harvey) Dixon							X	7
Trailliella intricata (J. Agardh) Batters	X			X	X	X	X	5
Subtotal	37	14	20	32	31	30	38	
TOTAL	81	45	47	59	66	65	80	

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